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09/989,566	11/20/2001	Yukuo Katayama	3094-32	1185

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EXAMINER

RIDLEY, BASIA ANNA

ART UNIT	PAPER NUMBER
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1764

DATE MAILED: 06/30/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/989,566

Applicant(s)

KATAYAMA, YUKUO

Examiner

Basia Ridley

Art Unit

1764

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 May 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-3,5 and 6 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3,5 and 6 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 October 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☒ Other: Translation of DE 2,044,310.

DETAILED ACTION

Information Disclosure Statement

1. The listing of references in applicants response is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references included in the response filed on 13 May 2005 have been cited by the examiner on form PTO-892, they have not been considered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1-3 and 5-6 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1-3 and 5-6 recite alternative limitations in form of improper Markush group (see claim 1, lines 4-5), and therefore said claims are indefinite. Proper Markush group recites its members as being "selected from the group consisting of: A, B, and C". See MPEP 2173.05(h).

Claim Rejections - 35 USC § 103

4. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

5. Claims 1-3 and 5-6 are rejected under 35 U.S.C. 102(b) as being anticipated by Carkeek et al. (USP 2,838,388) in view of Du Bois Eastman (USP 2,735,265).

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Regarding claim 1-2 and 5-6, Carkeek et al. discloses a method for gasification of coal wherein:

- a slurry of coal in water (11) and oxygen or air (10) are supplied to a gasification reactor (12); comprising
- heating (9) the slurry of coal in water to vaporize at least a part of the water (C3/L69-C4/4);
- feeding a mixture of coal, water and steam thus formed to the gasification reactor (C3/L69-C4/4); and
- feeding gaseous oxygen or air to the gasification reactor where the coal is subjected to partial oxidation and steam reforming (C1/L15-55); and
- separately withdrawing a gasification gas (14) and slag (13) from the gasification reactor (12).
- wherein substantially all of the water is supplied in a form of steam to the gasification reactor (C3/L69-C4/4);
- wherein a water content is in a range from 27 to 50 weight % based on a total weight of the slurry (C3/L1-15);
- wherein the coal is pneumatically transferred by steam into the gasification reactor, the steam being obtained by heating the slurry of coal in water (drawing).

While Carkeek et al. discloses that the slurry of coal in water is indirectly heated from 150°C to 450°C (C3/L62-C4/L4), the reference does not explicitly disclose any heating medium used for said heating.

Du Bois Eastman teaches a process for heating of slurry of coal in water from 150°C to 450°C to vaporize said water (C4/L37-38, C5/L57-C6/L5), wherein said slurry is preheated in an indirect heat exchanger (Fig.1 or 2) with a heating medium having a temperature of 200°C to 600°C

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and selected from the group consisting of high temperature steam, hot oil, molten salts, or gases or combination thereof (C5/L75-C6/L5).

As the instant specification is silent to unexpected results, it would have been obvious to one having ordinary skill in the art at the time of the invention to use a heating medium having a temperature of 200°C to 600°C and selected from the group consisting of high temperature steam, hot oil, molten salts, or gases or combination thereof, as taught by Du Bois Eastman, in the process of Carkeek et al., because doing so would amount to nothing more than a use of a known heat exchange medium for its intended use in a known environment to accomplish entirely expected result.

Regarding claim 3, Carkeek et al. discloses all of the claim limitations as set forth above, and additionally, the reference discloses that a mixture is supplied to the gasification reactor, the mixture being obtained by heating the slurry of coal in water from 150°C to 450°C to vaporize substantially all liquid present (C3/L69-74). While the reference does not explicitly disclose said vaporization occurring at the pressure of 0.2 MPa to 11.5 MPa, since the reference disclose that there exists known temperature and pressure relationship affecting vaporization (C4/L5-7), are well known, therefore vaporization at temperatures from 150°C to 450°C to vaporize substantially all liquid present, inherently, will be performed at the pressure of 0.2 MPa to 11.5 MPa.

6. Claims 1-3 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schlinger et al. (DE 2,044,310) in view of Du Bois Eastman (USP 2,735,265).

Regarding claim 1-3 and 6, Schlinger et al. discloses a method for gasification of coal wherein:

- a slurry of coal in water and oxygen or air are supplied to a gasification reactor (last paragraph on page 1, page 2 and 1st two paragraphs on page 3); wherein

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- the slurry of coal in water is heated to thereby vaporize at least a part of the water and fed to the gasification reactor (last paragraph on page 1, page 2 and 1st two paragraphs on page 3); and
- gaseous oxygen or air is fed to the gasification reactor where the coal is subjected to partial oxidation and steam reforming (last paragraph on page 1, page 2 and 1st two paragraphs on page 3); and
- a gasification gas and slag thus formed are withdrawn separately from the gasification reactor (last paragraph on page 1, page 2 and 1st two paragraphs on page 3).
- wherein substantially all of the water is supplied in a form of steam to the gasification reactor (last paragraph on page 1, page 2 and 1st two paragraphs on page 3);
- wherein the coal is pneumatically transferred by steam into the gasification reactor, the steam being obtained by heating the slurry of coal in water (last paragraph on page 1, page 2 and 1st two paragraphs on page 3).

Additionally Schlinger et al. discloses the process wherein the gasifier operates at a pressures of 0.2 MPa to 11.5 MPa and wherein said coal and water slurry is preheated to a predetermined temperature necessary to vaporize water in the slurry and fed directly to the gasifier (last paragraph on page 1, page 2 and 1st two paragraphs on page 3). Further the reference discloses that increasing the coal and water slurry temperature before charging into the gasifier reduces the heat burden on the gasifier and improves the utilization of the coal and oxygen (2nd paragraph on page 5), but the reference does not explicitly disclose said coal and water slurry being preheated to a temperature of 150°C to 450°C by a specific heating medium having temperature of 200°C to 600°C.

With respect to Du Bois Eastman the same comments apply as set forth above.

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7. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schlinger et al. (DE 2,044,310) in view of Du Bois Eastman (USP 2,735,265) and further in view of Carkeek et al. (USP 2,987,387).

Regarding claim 5, Schlinger et al. in view of Du Bois Eastman discloses all of the claim limitations as set forth above. Additionally, while the reference does not explicitly disclose specific water content of feed stream to the gasifier, the reference does state that a particularly effective method for dispersing powdered solid fuel in vapor is described in USP 2,987,387 (see page 3, lines 8-9).

Carkeek et al. discloses a method for dispersing powdered solid fuel in vapor, wherein said dispersed solid fuel is used in a gasifier to generate gas by partial oxidation and steam reforming, and wherein a water content is in a range from 27 to 50 weight % based on a total weight of the slurry. Further, the reference discloses that such slurry concentration is necessary to form a pumpable mixture (C2/L18-30).

It would have been obvious to one having ordinary skill in the art at the time of the invention to use in a process disclosed by Schlinger et al. in view of Du Bois Eastman a slurry having a water content in a range from 27 to 50 weight % based on a total weight of the slurry, as taught by Carkeek et al., for the purpose of providing a pumpable slurry.

Response to Arguments

8. Applicant's arguments filed on 13 May 2005 have been considered but are moot in view of the new ground(s) of rejection.

9. As a courtesy, upon applicant's request the examiner is providing a copy of translation of DE 2,044,310.

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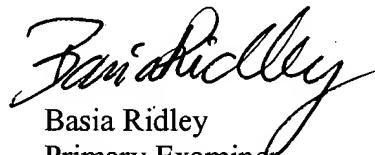
Conclusion

10. In view of the foregoing, none of the claims are allowed.
11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Basia Ridley, whose telephone number is (571) 272-1453.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn Caldarola, can be reached on (571) 272-1444.

The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Technical Center 1700 General Information Telephone No. is (571) 272-1700. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Questions on access to the Private PAIR system should be directed to the Electronic Business Center (EBC) at (866) 217-9197 (toll-free).


Basia Ridley
Primary Examiner
Art Unit 1764

BR
June 27, 2005

PROCESS FOR PRODUCING SYNTHETIC GAS FROM SOLID FUELS

[Verfahren zur Herstellung von Synthesegas
aus festen Brennstoffen]

Warren Gleason Schlinger et al

UNITED STATES PATENT AND TRADEMARK OFFICE

Washington, D.C.

April 2004

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Inventor : Warren Gleason Schlinger and
William Leon Slater

Applicant : Texaco Development Corporation,
New York, United States of America

IPC : C 10 J 3/16

Application Date : September 8, 1970

Publication Date : March 16, 1972

Foreign Language Title : Verfahren zur Herstellung von
Synthesegas aus festen
Brennstoffen

English Title : **PROCESS FOR PRODUCING SYNTHETIC
GAS FROM SOLID FUELS**

PROCESS FOR PRODUCING SYNTHETIC GAS FROM SOLID FUELS

The invention concerns a process for producing synthetic gas, that is $\text{CO} + \text{H}_2$, from solid carbon fuels by incomplete combustion in a gas containing oxygen. It concerns in particular the gasification of solid carbon fuels in a non-catalytic direct flow reaction, in which a slurry of solid fuel in water is introduced in the liquid phase in a reaction zone, which is kept at an autogenous temperature of about 980-1650 °C, and is there converted with relatively pure oxygen.

It is known to produce carbon monoxide and hydrogen, that is, synthetic gas, by way of a non-catalytic reaction of solid carbon fuels with oxygen or with O_2 from enriched air as well as water vapor. The partial combustion of solid fuels, such as coal or petroleum coke, represents a very economic process for producing synthetic gas in large quantities. In the direct flow gasification process or the partial combustion process, solid fuel is converted with a gas containing oxygen, preferably almost pure O_2 , in a closed, compact reaction zone in the absence

¹ Numbers in the margin indicate pagination in the foreign text.

of fillers or catalysts at an autogenous temperature within the range of about 980-1760 °C, preferably 1090-1540 °C.

The solid fuel is usually suspended in fine particle form in water vapor and is guided into the reaction zone, where it meets with a limited oxygen quantity. A reaction takes place almost immediately, which produces as main products carbon monoxide and hydrogen. The gasification process works most effectively at a high pressure, that is, 7-56 atü, and at temperatures over the melting point of the ash contained in the coal or the coke, so that molten slag is produced. The slag melt is discharged from the reactor through an outlet or an opening in the wall of the reactor, which is preferably at one end of the reaction zone, into a tempering zone, which contains water, into which the slag falls and in which it is tempered and solidifies.

Aside from CO and H₂, the product gas flow usually contains carbon dioxide, methane, and entrained non-converted carbon.

The carbon that is produced during the process can have the form of very fine soot particles and unchanged particles of the solid fuel. From the product gas flow can be obtained coal by joining the gas flow in a suitable gas/fluid contact container with water and feeding back the same as fuel into the synthetic gas generator.

The oxygen quantities fed to the reaction zone are limited with reference to the fuel supply, so that approximately maximum yields of CO and H₂ can be obtained in the gasification reaction. The use of highly pure oxygen, that is, oxygen-rich gas flows that contain more than 95 volume percent of oxygen should be preferred. These oxygen concentrations are easy to obtain in technical oxygen separating systems. /3

It has now been adopted to produce from the pulverized solid fuel a dispersion or suspension in a carrier gas, such as the fed back product gas, water vapor, or a mixture of synthetic gas and vapor, and to introduce this dispersion in the reaction chamber in a mixture with oxygen fed separately thereto.

A particularly effective method for dispersing powdered solid fuel in vapor is described in United States patent 2,987,387. In this process, solid fuel is mixed with water or an aqueous carrier and goes with a relatively high speed into a single tubular boiler, where the water is converted into vapor and a dispersion of the solid particles in vapor is produced. The obtained dispersion is then fed to a direct flow gasification system. A disadvantage of this known process is the difficult maintenance of the boiler plants, which are exposed on the inner surfaces of the heating tubes to the formation of boiler incrustations as well as erosion by the solid particles. The

process of the invention prevents this problem by making unnecessary the use of boilers or heating systems for the coal/water slurry with which the gas generator is pressurized. It was discovered that, in contrast with the state of the art, it is possible to successively gasify coal in a reactor system in which the coal is fed directly into the hot gasification chamber, which is kept at a temperature of more than approximately 980 °C, as aqueous slurry, in which sufficient water is used to convey the coal as pumpable slurry in water. For reasons of simplicity, the following description of the process of the invention refers to coal or coke as solid fuels. It is understood, however, that aside from petroleum coke, also other different coal types such as lignite, moor coal, brown coal, anthracite, and other solid hydrocarbons and carbon-rich solids can be gasified by means of the process of the invention.

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Pumpable slurries of grainy solid fuels in a liquid carrier can be produced by mixing powdered coal or coke powder with approximately equal weight parts of the liquid carrier. Suitable carrier liquids are water, hydrocarbon oils and water/oil emulsions. For the process of the invention is preferred a slurry of coal or coke in water, which contains approximately 45-55 percent by water of solids and is free-

flowing due to its water content. An excess of water should be avoided since it represents a heat burden on the reactor and reduces the utilization of the oxygen in the reaction.

The drawing depicts a flow diagram for a preferred embodiment of the process of the invention.

As shown in the drawing, solid fuel, such as coal or coke, is guided from a suitable source through the line 7 into a mixer 8, where it is converted with a carrier liquid into a slurry. To the mixer 8 can be fed water from the line 9. From the mixer 8, the coal/water slurry is forwarded by way of a line 11 into a thickener 12, where the excessive water is extracted from the mixture and a pumpable slurry of coal and water is produced, which contains approximately 45-55 percent by water of solid fuel. The water excess goes from the thickener 12 by way of a line 13 back to the mixer.

The slurry is extracted from the thickener 12 by way of a pump 14 and goes through the heating boiler 15 and the line 16 to a suitable mixer/burner 17, which is connected to the synthetic gas generator 18. In the heating boiler 15, the coal slurry is brought to a temperature that does not exceed the boiling temperature of water at the pressure that exists within the reaction zone 20. The heating boiler 15 can be completely

eliminated, if required. Oxygen is fed from a suitable source to the burner 17 by way of the line 19. The aqueous fuel slurry

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is introduced mixed with oxygen from the line 19 through a central pipe into the burner 17 directly at the upper end of the reaction zone 20 of the generator 18. The construction of the burner 17 in the gas generator is known. Suitable burners are described, for example, in the United States patents 2,928,459 and 2,928,460.

If a preheating boiler 15 is used, the same reduces the heat burden on the gas generator and improves the utilization of the fuel and oxygen. If coal is used as solid fuel for the gas generator, the preheating of the slurry serving as charge can be preferably limited to prevent an evaporation of the water from the slurry in the preheating boiler. In this case, all the water that is required for generating synthetic gas in the reaction zone 20 is fed in the liquid phase. If, however, petroleum coke is used as fuel for the gas generator, part of the water, that is, about 0-90 percent by weight, can be evaporated in the preheating boiler 15 without an excessive formation of boiler incrustations.

The synthetic gas generator 18 consists of a cylindrical pressure vessel 21 having a fire-resistant covering 22, which

defines a cylindrical, compact filler-free reaction zone 20. The mixture of coal, water and oxygen is guided by the burner 17 axially into the upper end of the reaction zone 20 through an inlet 23. From the lower end of the reaction zone 20, the reaction products are discharged axially through an outlet 24 into a slag tempering chamber 26. In the lower part of the tempering chamber 26 is located a water reservoir 27, and the upper part of the chamber 26 is provided with a water jacket 28, which protects the wall of the pressure vessel from overheating by the hot gases of the generator. Unchanged solid fuel and the slag or ash originating from the solid fuel flow with the product gas flow through the outlet 24 in the tempering chamber 26, where the greater particles of the solids and the molten ash or slag fall into the water reservoir. The gas flows out of

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the chamber 26 by way of the line 29, which is provided with a fire-resistant covering 30.

In the reaction zone 20 of the gas generator 18, the mixture of solid fuel, water and oxygen that flows out of the burner 17 reacts into a synthetic gas consisting of CO and H₂ at an autogenous temperature above approximately 980 °C, that is, at a temperature within the range between 1093-1538 °C. This synthetic gas still contains small portions of carbon dioxide,

inert atmospheric gases and solid fuel. Under the expression "synthetic gas" is herein understood a mixture consisting predominantly of CO and H₂, which is suitable as initial material for the synthesis of hydrocarbons and alcohols as hydrogen source for hydration reactions and NH₃ synthesis as well as reducing gas for ore reduction and the like.

The relative proportions of solid fuel, water and oxygen in the charge of the gas generator are carefully controlled to convert an essential part of the carbons, that is, approximately 85 percent by weight, into carbon oxides and to maintain an autogenous temperature of approximately 982-1760, preferably 1093-1538 °C, in the reaction zone. The generated gas flow contains, aside from uncombusted coal and ash, also carbon dioxide in proportions of about 10-20 volume percent with respect to the dry product, which can be produced in part by a water gas conversion reaction. Depending on the degree of purity of the fuel and oxygen, which are introduced into the process, the gas product contains usually still some nitrogen and argon.

Ash and uncombusted coal are stored in the water reservoir of the tempering chamber 26. The slag melt that forms in the reaction zone and that exits through the outlet 24 of the reaction chamber 20 falls directly into the water reservoir 27

of the slag chamber 26, where it solidifies immediately to a granulate. Water is fed into the tempering chamber 26 by way of the line 31. Accumulation of solids, such as solidified slag

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and uncombusted coal, are transferred according to need from the slag chamber 26 by way of the line 35, which is closed off by a valve 36, into the lock funnel 37. From the lock funnel 37, the collected solid material is removed through the line 39, which is provided with a valve 38. During the transfer of the solid materials from the slag chamber 26 into the lock funnel 37, the valve 36 is opened and the valve 38 is closed. The valve 36 is then closed and the lock funnel 37 is emptied by opening the valve 38 in the line 39. A suitable arrangement of the lock funnel is described, for example, in United States patent 2,931,715. Solid residues and water arrive from the lock funnel 37 by way of the line 39 in the sedimentation vessel 40.

From the sedimentation vessel 40 can be conveyed water and non-combusted coal by way of the line 41 into the mixer 8, from where they arrive in the charge of the synthetic gas generator. Water and relatively coal-free solids are discharged by way of the line 42. A flow of water is conveyed from the slag chamber 26 into the sedimentation vessel by way of a line 43 and controlled by way of a valve 44, which coacts with a liquid

level controller 45 to maintain an essentially constant water level in the slag chamber 26.

In the pressure vessel 21, an inner water jacket 28 is arranged in the upper part of the slag chamber 26. The water jacket 28 prevents the overheating of the walls of the pressure vessel underneath the lining 22, which encloses the reaction zone 20, and the water level in the chamber 26. Water runs from the line 47 toward the water jacket 28 and exits the same through the line 48.

The hot gas product that flows from the reaction zone 20 of the synthetic gas generator by way of the outlet 24 in the upper part of the slag chamber 26 arrives from there via the line 29 in a gas washer 50. Water is injected through the nozzles 52 and 53 from the line 51 into the gas washer 50. In the gas/washer 50, which has preferably a venturi, nozzle or punched plate construction, is effected a close contact between the gas product of the line 29 and water of the line 51. In the gas washer 50, the gas flow is accelerated and water is injected from a multitude of nozzles 52, of which two are shown in the drawing, at the narrowest location of the cross section. Additional water is also injected at the inlet of the gas washer 50 from a multitude of nozzles 53, of which only two are shown in the drawing, to prevent an overheating of the gas washer.

The gas/water mixture formed in the gas washer 50 is guided into the separator 55 through an immersion nozzle 56, which ends in the lower part of the separator 55. The gas flow coming from the washer 50 contains still solid particles of uncombusted fuel or ash. In the separator 55 is located a water reservoir, whose level is controlled in a known way, for example, by way of a liquid level controller 57. The immersion nozzle 56 discharges the mixture of gas and water below the water level into the separator. When the gas/water mixture flows out through the end of the immersion nozzle 56 it comes into immediate contact with the water reservoir, and the solid particles are retained in the water reservoir.

The separator 55 has suitably the shape of a tower and contains a filler part 58, which is arranged above the inlet for the gas flow from the washer 50. Water from the line 48 is guided into the separator 55 via the filler part 58. In the filler part 58, the gas flow is mixed thoroughly with water in the presence of suitable fillers, for example, of ceramic, while the solid particles are washed almost completely from the gas flow. The gas product, which contains CO, H₂, water vapor, atmospheric gases and CO₂, flows from the upper end of the separator 55 by way of the line 60 at a temperature that corresponds to the

equilibrium evaporation temperature of water at the pressure existing in the separator 55. The purified gas product of the line 60 can then be further processed, for example, for use/9 in the production of hydrogen by way of the water gas conversion reaction or for cleaning in a suitable way.

Water from the lower part of the separator 55 is conveyed by the pump 61 by way of the line 51 to the nozzles 52 and 53.

Clarified water from the sedimentation vessel 40 can also be fed to the line 51 by the pump 62 by way of the line 63. Water is extracted by the pump 64 from the separator 55 and is pressed by way of the valve 65, which is actuated by the liquid level controller 57, into the tempering zone 26 by way of the line 31 to control the liquid level in the separator 55.

The solid particles that are removed from the gas flow in the separator 55 deposit in the water reservoir and collect in the stubs 66, from which they can be then periodically discharged by way of a line 67, which is provided with a valve 68.

Examples

In the following examples of the process of the invention is used a slurry of coke and water and the same is fed without preheating as charge into a filler-free direct flow synthetic gas generator with a capacity of 0.333 m^3 . The coke charge of

these examples had the following elementary analysis in percent by weight.

Analysis of the Fuel

	<u>Examples 1-3</u>	<u>Example 4</u>
Carbon	88.01	85.77
Hydrogen	3.63	3.65
Oxygen	3.06	4.24
Nitrogen	2.30	2.21
Sulfur	1.09	1.05
Unknown	1.91	3.08

The working conditions and results are compiled in the following table.

	<u>/10</u>			
<u>Example No.</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
<u>Fuel Charge</u>				
Coke, kg/h	239.1	256.4	263.4	236.9
Water, kg/h	221.0	217.6	217.6	210.4
Coke content in charge, % by weight	52.0	54.2	54.8	51.0*
Temperature at the burner, °C	28.3	41.1	38.9	---
*Aside from coke were contained 2% molasses in the slurry				
<u>Oxygen Charge</u>				
Flow rate, Nm ³ /h	206.9	204.5	208.8	183.6
Temperature at the burner, °C	149.0	144.8	144.8	---
<u>Working Conditions</u>				
Generator temperature, °C	1371	1404.5	1446	1321
Generator pressure, atü	27.4	28.34	14.2	28.1
Test duration, h	3	8	5	3

Product

Gas flow, dry, Nm ³ /h	624.7	625.7	600.3	654.8
Composition, volume %				
Hydrogen	33.12	34.24	32.19	37.17
Carbon monoxide	46.46	45.99	49.01	42.89
Carbon dioxide	19.00	18.69	17.76	18.92
Methane	0.02	0.05	0.09	0.16
Carbonyl sulfide	0.04	0.02	0.04	0.02
Hydrogen sulfide	0.10	0.18	0.00	0.03
Nitrogen	1.15	0.68	0.78	0.69
Argon	0.11	0.15	0.13	0.12

Process Yields

Oxygen/fuel ratio, Nm ³ /kg	0.8644	0.7965	0.7969	0.7728
Water/fuel ratio, kg/kg	0.92	0.85	0.82	0.89
Oxygen/carbon equivalent ratio	0.996	0.918	0.912	0.914
H ₂ + CO, Nm ³ /h, under pressure (forced) O ₂ consumption Nm ³ /1000 Nm ³ H ₂ + CO,				
net	412.3	406.4	419.0	362.9
Uncombusted carbon % by weight	0.51	8.82	10.31	2.47

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Patent Claims

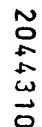
1. A process for the production of carbon monoxide and hydrogen from solid fuel in a filler-free reaction zone via direct partial oxidation with oxygen and water vapor at an autogenous temperature within the range of about 980-1650 °C, wherein the solid fuel is introduced in fine particle form as slurry in liquid water, which contains 45-55 percent by

weight of solid fuel, into the reaction zone and a gas containing oxygen is fed mixed with the slurry into this reaction zone at the location where the slurry is introduced, in such a way that at least 75% of the carbon contained in the fuel is converted into carbon oxides and the autogenous temperature is kept within the range of about 980-1650 °C.

2. The process of claim 1, wherein the reaction is carried out under a pressure of about 7-211 atü.
3. The process of claim 1 or 2, wherein to the slurry of solid fuel is admixed a liquid hydrocarbon in a quantity that does not exceed 25 percent by weight of the slurry.
4. The process of claims 1-3, wherein a gas containing at least 95 volume percent of O₂ is used as gas containing oxygen.
5. The process of one of the claims 1-4, wherein the fuel slurry is preheated to a temperature that is below the evaporation

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temperature of water at the pressure that exists in the reaction zone before being introduced into the reaction zone.



Texaco Development
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Wasser = Water; Fester Brennstoff = Solid fuel; Mischer = Mixer;
Eindicker = Thickener; Vorwärmer = Preheater; Heizkessel =
Heating boiler; Wasser u. Kohle = Water and coal; Wasser u.
Feststoffe = Water and solids; Kohle u. Wasser = Coal and water;
Sauerstoff = Oxygen; Schlußbühnen = Lock funnel;
Gasgenerator = Gas generator; Geklärtes Wasser = Clarified
water; Absetzgefäß = Sedimentation vessel; Abscheider =
Separator; Feststoffe = Solids.